In the United States Court of Federal Claims

OFFICE OF SPECIAL MASTERS

(Filed: March 19, 2018)

No. 13-901

STEVE LEHRMAN,	*	To Be Published
Petitioner,	*	
v.	*	Ruling on Entitlement; Influenza ("Flu") Vaccine; Guillain-Barre Syndrome ("GBS")
SECRETARY OF HEALTH AND HUMAN SERVICES,	*	
Respondent.	*	

Sylvia Chin-Caplan, Law Office of Sylvia Chin-Caplan, Boston, MA, for petitioner.
Darryl Wishard, U. S. Department of Justice, Washington, DC, for respondent.

RULING ON ENTITLEMENT[1]

Roth, Special Master:

On November 13, 2013, Steve Lehrman ("Mr. Lehrman," or "petitioner") filed a petition for compensation under the National Vaccine Injury Compensation Program, 42 U.S.C. § 300aa-10, et seq.[2] (the "Vaccine Act" or "Program"), alleging that the influenza vaccination that petitioner received on October 25, 2011 caused him to develop Guillain-Barré Syndrome ("GBS"). Petition at 1.

An entitlement hearing was held on June 20, 2017, in Washington, D.C. For the reasons stated herein, I find that petitioner has proffered sufficient evidence to demonstrate that the influenza vaccine that he received on October 25, 2011 more likely than not contributed to his development of GBS. Accordingly, I find that the petitioner is entitled to compensation.

[1] Because this published ruling contains a reasoned explanation for the action in this case, I intend to post this decision on the United States Court of Federal Claims' website, in accordance with the E-Government Act of 2002, Pub. L. No. 107-347, § 205, 116 Stat. 2899, 2913 (codified as amended at 44 U.S.C. § 3501 note (2012)). In accordance with Vaccine Rule 18(b), a party has 14 days to identify and move to delete medical or other information that satisfies the criteria in § 300aa-12(d)(4)(B). Further, consistent with the rule requirement, a motion for redaction must include a proposed redacted decision. If, upon review, I agree that the identified material fits within the requirements of that provision, I will delete such material from public access.

[2] National Childhood Vaccine Injury Act of 1986, Pub. L. No. 99-660, 100 Stat. 3755. Hereinafter, for ease of citation, all "§" references to the Vaccine Act will be to the pertinent subparagraph of 42 U.S.C. § 300aa (2012).

A. Procedural and Medical History

A. Procedural History

Petitioner filed his petition on November 13, 2013 and medical records on November 19, 2013. Petitioner's Exhibits ("Pet. Exs.") 1-15, ECF Nos. 5, 6. On February 24, 2014, respondent filed a Rule 4(c) Report ("Rule 4") stating that compensation was not appropriate. ECF No. 12.

On September 12, 2014, petitioner filed the expert report of Dr. Morgan, a neurologist along with supporting literature. Pet. Ex. 16-17, ECF No. 19. On January 14, 2015, respondent filed an expert report of Dr. Chaudhry, a neurologist, along with supporting literature. Resp. Ex. A-C, ECF No. 24. On April 13, 2015, petitioner filed a supplemental report from Dr. Morgan. Pet. Ex. 18, ECF No. 29. On June 11, 2015, respondent filed a supplemental report from Dr. Chaudhry and supporting medical literature. ECF No. 33.

Thereafter, on December 14, 2015, petitioner filed the expert report of Dr. Norman Latov, a neurologist. Pet. Ex. 22-23, ECF No. 49. On March 23, 2016, respondent filed a responsive expert report from Dr. Chaudhry. Resp. Ex. I-L, ECF No. 51. On June 28, 2016, petitioner filed a supplemental expert report from Dr. Latov. Pet. Ex. 24, ECF No. 54.

A prehearing order was issued on July 13, 2016, setting this matter for an entitlement hearing on May 23 and 24, 2017, in Washington, D.C. Prehearing Order, ECF No. 57. On August 11, 2016, petitioner filed updated medical records. Pet. Ex. 25-28, ECF No. 58.

On January 5, 2017, petitioner filed a Motion for Interim Attorneys' Fees and Costs. ECF No. 60. Petitioner then filed a motion to substitute Sylvia Chin-Caplan as counsel in place of Ron Homer. ECF No. 63. Mr. Homer was awarded interim attorneys' fees and costs. Decision, ECF No. 65.

The entitlement hearing scheduled for May 23 and 24, 2017 was postponed until June 20, 2017 due to unavailability of petitioner's expert, Dr. Latov. Petitioner filed his pre-hearing brief on May 2, 2017. ECF No. 70. Respondent filed his pre-hearing brief on May 12, 2017. ECF No. 71.

An entitlement hearing was held in Washington, D.C. on June 20, 2017. The parties filed post-hearing briefs on August 21, 2017. ECF Nos. 84-85.

B. Medical History

1. Petitioner's Health Prior to Receiving the Influenza Vaccine

Petitioner was born on November 29, 1974. Pet. Ex. 2 at 1.

Petitioner received his primary care at Poland Family Practice ("Poland") where he was treated on January 15, 2009, for pink eye; October 21, 2009, for a skin abscess over the clavicle

on the right chest; and on April 14, 2010, for 24 hours of nausea, vomiting, and diarrhea. Pet. Ex. 2 at 3, 6-7.

On June 28, 2011, petitioner presented to Poland Medical Center with complaints of sinus congestion, sinus drainage, and a cough. Pet. Ex. 2 at 3. Petitioner had unspecified hypertension for which he took Lisinopril. He had stopped taking the medication and his blood pressure was elevated. *Id*. He was prescribed cough medicine and an antibiotic. *Id*. at 4.

On August 10, 2011, petitioner returned to Poland, complaining of a persistent cough ongoing for two months. Pet. Ex. 2 at 1. He denied fever, chills, or other associated symptoms. *Id*. He was diagnosed with acute bronchitis, sinusitis, acute bronchospasm, and unspecified hypertension. *Id*. Petitioner was noted to have a dry barky cough and was coughing frequently. Petitioner was prescribed antibiotics and an inhaler. *Id*. at 2.

On October 25, 2011, petitioner received the influenza vaccine at work. Pet. Ex. 9 at 1.

2. Petitioner's Health After Receiving the Influenza Vaccine

On October 27, 2011, petitioner presented to the emergency room at Jefferson Regional Medical Center where he came under the care of Dr. Jenifer. Petitioner complained of pain in his shoulder blades for about two days, followed by progressive numbness, tingling of his left arm and left leg, and weakness in his right arm. Pet. Ex. 3 at 3. He further reported having difficulty putting his clothes on that morning due to poor function in his right hand. Dr. Jenifer noted that petitioner had poor coordination in his right arm and had difficulty lifting it over his head. *Id*. at 4. He also had difficulty with his gait, with a little bit of shuffling and unsteadiness on turns. He had good deep tendon reflexes which were symmetrical. The differential diagnosis was "Rule out MS, transverse myelitis, transient ischemic attack, cerebrovascular accident, electrolyte imbalance, cardiac dysrhythmia." *Id*. Petitioner was admitted for observation. *Id*. A recent flu vaccine and an intent to monitor for possible reaction to the flu vaccine was noted. "It does not appear to be a Guillain Barr [sic] syndrome. It is not an ascending paralysis, and he is able to ambulate." *Id*. Dr. Jenifer's final diagnosis was "Bilateral arm and leg weaknesses. Rule out neurological event." *Id*.

Petitioner was examined by Dr. Richard Weisman, a neurologist, on October 27, 2011. Dr. Weisman wrote

> Two mornings ago he awakened with pain in his left arm, the left upper chest, and through to his back and along with this was a feeling of numbness in the arm. This abated. Later in the day he got a flu shot without any incident. Yesterday, he awakened with numb feeling involving the entire left side of his body from the neck down along with a feeling of weakness and today this spread to the right side. He says that he can barely stand or walk and cannot use his arms and hands normally. He describes weakness, numbness and pain.

Pet Ex. 3 at 12. Upon examination, Dr. Weisman noted that petitioner was anxious, and when asked to produce voluntary muscular contractions, moved his limbs in a very wild and irregular fashion with a little bit of clumsiness and fluctuation in effort. When asked to contract a muscle of

his upper or lower extremity, he made intense facial grimaces. With any resistance, he had a sudden collapse of muscular effort and a lack of follow through. Deep tendon reflexes were diffusely hypoactive and plantar responses were silent. With standing and walking, there was a lot of body gyration and he arched his back and lurched forward. All work up so far was normal. Dr. Weisman stated that the clinical presentation was suggestive of hysterical conversion reaction but it would be important to evaluate and exclude for unusual immune reaction. A lumbar puncture was ordered to evaluate for Miller Fisher variant of GBS. Dr. Weisman thought petitioner was having symptoms before the flu vaccine so it was probably unrelated. *Id*. at 12-13.

On October 28, 2011, Dr. Menon examined petitioner and noted that he presented yesterday complaining of weakness. He awoke two days ago with his entire left side feeling weak, including his upper and lower extremities. This gradually improved. Yesterday, he woke up with the entire right side of the body feeling weak. He was unable to stand or walk or use his arms normally. He had a flu vaccine a couple of days ago and an upper respiratory infection 3 to 4 weeks ago. Pet. Ex. 3 at 10. Dr. Menon noted that according to neurology, petitioner developed this before getting the flu vaccine and there are some inconsistencies in his history. *Id*. at 11. A lumbar puncture showed white blood count at 2 and protein slightly elevated at 55. All other testing was normal or negative. *Id*.

A handwritten consultation record with Dr. Manneheimer, a psychiatrist, dated October 29, 2011, stated that petitioner was admitted on October 27, 2011, with "inability to get out of bed had the flu shot – states symptoms developed afterward." Pet. Ex. 11 at 13. He had no psychiatric history. *Id*. Dr. Manneheimer noted "probable conversion disorder [but it was] hard to be sure." *Id*.

Dr. Manneheimer saw petitioner again the following day, October 30, 2011; he again noted that petitioner stated that all of his symptoms started after the flu vaccine. Pet. Ex. 11 at 21. His fiancée was present and advised that they met in May and recently bought a home. *Id*. Petitioner said he had relocated to Pittsburgh for a new job and previously lived with his mother in Ohio. *Id*. He denied any psychiatric past or alcohol use; he admitted to having been under some stress but felt he was handling it. *Id*. He noted some depression after his dad passed in 2008, but did not seek any treatment for it. *Id*. He and his fiancée believe all of his symptoms were related to the flu shot. Dr. Manneheimer's impression was possible conversion disorder. *Id*.

On October 30, 2011, petitioner was seen by Dr. Mehta for a rehabilitation evaluation. Dr. Mehta noted that petitioner was admitted with acute onset of weakness. Pet. Ex. 11 at 23. "He had a flu shot the day prior then started having symptoms of diffuse weakness, and numbness, and to a lesser extent pain issues." *Id*. He had an extensive work up, which was negative. *Id.* There was some suspicion of conversion reaction. *Id*. MRIs of the brain, cervical spine, and thoracic spine were normal. *Id*. Dr. Mehta noted that petitioner had "diffuse weakness and ataxia of unclear etiology. Differential diagnosis would include conversion reaction, atypical neuropathy among others." *Id*. The EMG study on that date was unremarkable; there was no definite evidence of GBS, myopathy, or focal nerve damage noted. Pet. Ex. 7 at 14.

On November 1, 2011, Dr. Charles Gennaula was consulted for a second neurological opinion regarding petitioner's weakness. Pet. Ex. 11 at 15. Petitioner reported that his health had

been normal until receiving a flu shot; he awoke the next morning with weakness. *Id*.; Tr. 130. All testing was normal. Pet. Ex. 11 at 15. A lumbar puncture showed mildly elevated CSF protein but a normal white count. *Id*. at 128. However, petitioner was having atypical movements with weakness; his arms were still weak, but his legs were improving. *Id*. at 15. Dr. Gennaula's impression was atypical pattern weakness. Petitioner's work-up was unrevealing; Dr. Gennaula agreed that he may have a conversion disorder due to the atypical distribution and development of the weakness. *Id*. Dr. Gennaula suggested a follow-up EMG to rule out atypical GBS. *Id*. at 16.

A repeat EMG performed on November 2, 2011 by Dr. Kirby noted "[Petitioner] has decreased recruitment in the affected muscles that appears to be more neurologically mediated than effort dependent. He has 1-2+ spontaneous activity in the deltoid muscles bilaterally with only discrete motor units notable." Pet. Ex. 1 at 75. Dr. Kirby further noted that, while petitioner's treaters were concerned about conversion disorder, the electrodiagnostic studies were "strikingly abnormal" and "significantly different" from the previous EMG. *Id*. Curiously, petitioner had "spontaneous activity in the deltoid muscles that would not be expected if this were a pure demyelinating motor neuropathy" as well as a lack of inflammatory markers. *Id*. at 76; Pet. Ex. 7 at 2. Dr. Kirby's overall impression was that petitioner had an atypical acute neuropathy. *Id*.

In an addendum written on November 3, 2011, Dr. Gennaula wrote that further evaluation with EMG and nerve conduction studies showed an evolving change with significant neuropathic changes on the studies that were not present on the last study. Pet. Ex. 11 at 16. He recommended treatment with gamma globulin, which was initiated. *Id*. Dr. Gennaula noted that he discussed petitioner's case with him in detail. The first EMG was normal but the next one several days later was abnormal. He explained to petitioner that he may have atypical GBS. *Id*.

Petitioner was transferred to inpatient rehabilitation on November 4, 2011. Pet. Ex. 1 at 44. The discharge summary from Jefferson noted that petitioner was transferred with a diagnosis of "Atypical neuropathic condition, possibly Guillain-Barre from flu shot with abnormal EMGs on repeat. Some increased protein in the cerebrospinal fluid without definitive disease. Anxiety with concern for conversion disorder." Pet. Ex. 11 at 271. Petitioner's hospital course was summarized as follows:

> The patient presented to the hospital on the day of admission with complaints of pain in the shoulder blades of two days' duration, progressive numbness and tingling in left arm and left leg with increased weakness in the right arm. The only antecedent event was a flu shot, which was a few days prior. He was seen by both associates [of] Neurology and Dr. Gennaula. His EMGs were repeated twice and second time did show some definitive abnormalities with the interpretation being….[D]ecreased recruitment in the affected muscles pretty more, [sic] neurologically mediated than effort dependent, atypical acute neuropathy was the diagnosis….He had a spinal tap, which is rather unremarkable except for some increased protein at 55, normal being 45 in the CSF, otherwise it was unremarkable. His ANA at 1 to 40 speckled does not felt [sic] to be significant. His blood count was normal. His thyroid was normal.

Id. at 271. Petitioner was being treated with IVIG, which was to continue at in-patient rehabilitation. *Id*. Petitioner received IVIG and physical therapy at the rehabilitation facility until his discharge on November 16, 2011. Pet. Ex. 1 at 44; Pet. Ex. 10 at 82-83.

A post-rehabilitation admission evaluation was conducted by Dr. Mehta on November 4, 2011. Dr. Mehta noted that petitioner had a flu shot "the day prior" to having symptoms of diffuse weakness and numbness. Pet. Ex. 7 at 3. An EMG performed two days earlier showed symptoms consistent with atypical GBS. *Id*. Dr. Mehta recommended a combination of physical and occupational therapy to improve petitioner's performance of activities of daily living. *Id*. at 4.

On November 8, 2011, petitioner was examined by a rheumatologist, Dr. Gorantla, for the positive ANA titer of 1:40. Pet. Ex. 1 at 48. Dr. Gorantla noted that petitioner developed diffuse extremity weakness one day after receiving a flu vaccine and had been diagnosed with atypical GBS, which was being treated with IVIG. *Id*. Dr. Gorantla stated that petitioner did not have any symptoms suggestive of lupus or similar rheumatological diseases, and opined that petitioner's positive ANA was not "of any significance." *Id*. at 49.

Upon his discharge from the rehabilitation facility, petitioner had diagnoses of anxiety, constipation, hypertension, GERD, increased cerebrospinal fluid ("CSF") protein without definitive disease, and atypical GBS with abnormal EMGs, suspected to be from a flu shot. Pet. Ex. 1 at 44; Pet. Ex. 10 at 62. He was prescribed Xanax. At the time of discharge, petitioner was able to walk without assistance, and his upper extremity strength had improved. *Id*.

Another discharge summary by Rachelle A. Scott, PA-C, noted that petitioner had a flu shot one day prior to developing diffuse weakness and numbness. Pet. Ex. 1 at 46. His discharge diagnosis was atypical Guillain-Barré syndrome with gait dysfunction, upper extremity weakness and numbness, and debility. *Id*.

After his discharge from in-patient rehabilitation, petitioner received occupational and physical therapy from UPMC/Jefferson Regional Home Health from November 17, 2011 through December 12, 2011. Pet. Ex. 8 at 1. At follow-up visits with his internist and neurologist, petitioner was noted to be improved. Pet. Ex. 1 at 19; Pet. Ex. 4 at 1. Both his physical and occupational therapists noted that petitioner had trouble completing tasks due to upper extremity weakness. Pet. Ex. 5 at 1, 5. Petitioner continued to participate in therapy until January 4, 2012. *Id*. at 11. Shortly thereafter, he returned to work full-time. Pet. Ex. 4 at 5. Petitioner later experienced increased weakness in both wrists and his right thumb and shoulder, which resolved over time. Pet. Ex. 4 at 8, 11; Pet. Ex. 6 at 4; Pet. Ex. 10 at 6, 48; Pet. Ex. 12 at 16. As of November of 2013, there appear to be no residuals of petitioner's GBS/AIDP. *See generally* Pet. Ex. 21.

C. The Experts

1. Petitioner's Experts: Thomas Morgan and Norman Latov

Thomas Morgan, M.D. is a board certified neurologist and medical examiner. He is an Assistant Professor in the Department of Clinical Neuroscience at Brown University School of Medicine. Pet. Ex. 17 at 4. Dr. Morgan is a member of the admitting staff and Consultant of

Neurology at Lifespan Health Connection, Rhode Island Hospital and Senior Staff at Kent County Hospital. *Id*. at 4.

Norman Latov has an M.D. as well as a Ph.D. in pathology, both from the University of Pennsylvania. Pet. Ex. 23 at 1. He is board certified by the American Board of Psychiatry and Neurology. Pet. Ex. 22 at 1. Since 2001, Dr. Latov has served as both an attending neurologist at New York Presbyterian Hospital and a professor of neurology and neuroscience at Weill Medical College of Cornell University. Pet. Ex. 23 at 2. He is a member of the National Advisory Council for The Neuropathy Association and an editorial board member for the journal *BMC Neurology*. *Id*. at 3. Dr. Latov has devoted a substantial portion of his practice to evaluation, diagnosis, and treatment of patients with autoimmune neurological diseases, including GBS. He has completed a fellowship in immunology, and previously headed a laboratory of neuroimmunology that conducted research into the mechanism of autoimmune peripheral neuropathies. Pet. Ex. 22 at 1.

2. Respondent's Expert: Vinay Chaudhry

Dr. Vinay Chaudhry received his Bachelor of Medicine and Bachelor of Surgery degrees from All India Institute of Medical Sciences. Resp. Ex. B at 1. He is board-certified in neurology, electrodiagnostic medicine, clinical neurophysiology, and neuromuscular medicine. *Id*. at 28. Dr. Chaudhry has served as a professor of neurology at Johns Hopkins since 2004, where he has chaired the neurology credentials committee since 2009. *Id*. at 3, 29. He has acted as a consultant for respondent regarding cases in the Vaccine Program since 1999. *Id*. at 31. Dr. Chaudhry is a member of the editorial board for the journal *Neurologist*. *Id*. Dr. Chaudhry is an expert on electrodiagnostic (nerve conduction and EMG) studies as they relate to neuromuscular diseases. He has an active clinical practice and is involved in clinical research and teaching at the Johns Hopkins Hospital in Baltimore, MD. Resp. Ex. A at 1; Tr. 82-83.

II. Legal Framework

The Vaccine Act provides two avenues for petitioners to receive compensation. First, a petitioner may demonstrate a "Table" injury—i.e., an injury listed on the Vaccine Injury Table that occurred within the provided time period. § 11(c)(1)(C)(i). "In such a case, causation is presumed." *Capizzano v. Sec'y of Health & Human Servs.*, 440 F.3d 1317, 1320 (Fed. Cir. 2006); *see* § 13(a)(1)(B). Second, where the alleged injury is not listed on the Vaccine Injury Table, a petitioner may demonstrate an "off-Table" injury, which requires that the petitioner "prove by a preponderance of the evidence that the vaccine at issue caused the injury." *Capizzano*, 440 F.3d at 1320; *see* § 11(c)(1)(C)(ii).

To prove causation, petitioner must satisfy the three-pronged test established in *Althen v. Sec'y of Health & Human Servs.*, 418 F.3d 1274 (Fed. Cir. 2005). *Althen* requires that petitioner show by preponderant evidence that a vaccination petitioner received caused his injury "by providing: (1) a medical theory causally connecting the vaccination and the injury; (2) a logical sequence of cause and effect showing that the vaccination was the reason for the injury; and (3) a showing of a proximate temporal relationship between vaccination and injury." *Id.* at 1278. Together, these prongs must show "that the vaccine was 'not only a but-for cause of the injury but also a substantial factor in bringing about the injury.'" *Stone v. Sec'y of Health & Human Servs.*,

676 F.3d 1373, 1379 (Fed. Cir. 2012) (quoting *Shyface*, 165 F.3d at 1352-53). Causation is determined on a case-by-case basis, with "no hard and fast *per se* scientific or medical rules." *Knudsen v. Sec'y of Health & Human Servs.*, 35 F.3d 543, 548 (Fed. Cir. 1994). A petitioner is not required to identify "specific biological mechanisms" to establish causation, nor are they required to present "epidemiologic studies, rechallenge, the presence of pathological markers or genetic disposition, or general acceptance in the scientific or medical communities." *Capizzano*, 440 F.3d at 1325 (quoting *Althen*, 418 F.3d at 1280). "[C]lose calls regarding causation are resolved in favor of injured claimants." *Althen*, 418 F.3d at 1280.

Additionally, a petitioner need not show that the vaccination was the sole cause, or even the predominant cause, of the alleged injury; showing that the vaccination was a "substantial factor" and a "but for" cause of the injury is sufficient for recovery. *Pafford v. Sec'y of Health & Human Servs.*, 451 F.3d 1352, 1355 (Fed. Cir. 2006); *Shyface v. Sec'y of Health & Human Servs.*, 165 F.3d 1344, 1352 (Fed. Cir. 1999).[3] Once a petitioner has proven causation by preponderant evidence, "the burden then shifts to the respondent to show by a preponderance of the evidence that the injury is due to factors unrelated to the administration of the vaccine." *Deribeaux ex rel. Deribeaux v. Sec'y of Health & Human Servs.*, 717 F.3d 1363, 1367 (Fed. Cir. 2013) (citing § 13(a)(1)(B)).

The process for making factual determinations in Vaccine Program cases begins with analyzing the medical records, which are required to be filed with the petition. § 11(c)(2). Medical records created contemporaneously with the events they describe are presumed to be accurate and "complete" such that they present all relevant information on a patient's health problems. *Cucuras v. Sec'y of Health & Human Servs.*, 993 F.2d 1525, 1528 (Fed. Cir. 1993). In making contemporaneous reports, "accuracy has an extra premium" given that the "proper treatment hang[s] in the balance." *Id.* Contemporaneous medical records that are clear, consistent, and complete warrant substantial weight "as trustworthy evidence." *Id*. Indeed, "where later testimony conflicts with earlier contemporaneous documents, courts generally give the contemporaneous documentation more weight." *Campbell ex rel. Campbell v. Sec'y of Health & Human Servs.*, 69 Fed. Cl. 775, 779 (2006); *see United States v. U.S. Gypsum Co.*, 333 U.S. 364, 396 (1948). But petitioners can support their claim with oral testimony if it is credible and consistent with the medical records. *See, e.g.*, *Stevenson ex rel. Stevenson v. Sec'y of Health & Human Servs.*, No. 90-2127V, 1994 WL 808592, at *7 (Fed. Cl. Spec. Mstr. June 27, 1994) (crediting the testimony of a fact witness whose "memory was sound" and "recollections were consistent with the other factual evidence"). In short, "the record as a whole" must be considered. § 13(a).

Furthermore, establishing a sound and reliable medical theory connecting the vaccine to the injury often requires a petitioner to present expert testimony in support of his or her claim. *Lampe v. Sec'y of Health & Human Servs.*, 219 F.3d 1357, 1361 (Fed. Cir. 2000). The Supreme Court's opinion in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993), requires that courts determine the reliability of an expert opinion before it may be considered as evidence. "In short, the requirement that an expert's testimony pertain to 'scientific knowledge' establishes a standard of evidentiary reliability." *Id*. at 590 (citation omitted). Thus, for Vaccine Act claims, a

[3] The Vaccine Act also requires petitioners to show by preponderant evidence that the "residual effects or complications" of the alleged vaccine-related injury lasted for more than six months. § 11(c)(1)(D)(i). It is undisputed that this six-month requirement is satisfied in this case.

"special master is entitled to require some indicia of reliability to support the assertion of the expert witness." *Moberly ex rel. Moberly v. Sec'y of Health & Human Servs.*, 592 F.3d 1315, 1324 (Fed. Cir. 2010). The *Daubert* factors are used in the *weighing* of the reliability of scientific evidence proffered. *Davis v. Sec'y of Health & Human Servs.*, 94 Fed. Cl. 53, 66-67 (2010) ("uniquely in this Circuit, the *Daubert* factors have been employed also as an acceptable evidentiary-gauging tool with respect to persuasiveness of expert testimony already admitted"). Where both sides offer expert testimony, a special master's decision may be "based on the credibility of the experts and the relative persuasiveness of their competing theories." *Broekelschen v. Sec'y of Health & Human Servs.*, 618 F.3d 1339, 1347 (Fed. Cir. 2010) (citing *Lampe*, 219 F.3d at 1362). And nothing requires the acceptance of an expert's conclusion "connected to existing data only by the *ipse dixit* of the expert," especially if "there is simply too great an analytical gap between the data and the opinion proffered." *Snyder ex rel. Snyder v. Sec'y of Health & Human Servs.*, 88 Fed. Cl. 706, 743 (2009) (quoting *Gen. Elec. Co. v. Joiner*, 522 U.S. 136, 146 (1997)).

III. Analysis

A. Reputable Medical Theory

The first *Althen* prong requires petitioner to provide a "reputable medical theory" demonstrating that the vaccines received *can* cause the type of injury alleged. *Pafford*, 451 F.3d at 1355-56 (citation omitted). To satisfy this prong, petitioner's "theory of causation must be supported by a 'reputable medical or scientific explanation.'" *Andreu ex rel. Andreu v. Sec'y of Health & Human Servs.*, 569 F.3d 1367, 1379 (Fed. Cir. 2009) (quoting *Althen*, 418 F.3d at 1278). This theory need only be "legally probable, not medically or scientifically certain." *Id.* at 1380 (emphasis omitted) (quoting *Knudsen*, 35 F.3d at 548). Nevertheless, "petitioners [must] proffer trustworthy testimony from experts who can find support for their theories in medical literature." *LaLonde v. Sec'y of Health & Human Servs.*, 746 F.3d 1334, 1341 (Fed. Cir. 2014).

Following a review of the 2012 Institute of Medicine ("IOM") report, which was developed after the IOM conducted a comprehensive review of the scientific literature on vaccines and adverse events, the committee charged with this review (the Advisory Commission on Childhood Vaccines, or "ACCV") agreed to proposed changes to the Vaccine Table. In accordance with section 312(b) of the National Childhood Vaccine Injury Act of 1986, Title III of Public Law 99-660, 100 Stat. 3779 (42 U.S.C. § 300aa-1 note) and section 2114(c) of the Public Health Service Act as amended (PHS Act)(42 U.S.C. § 300aa-14(c)), the following change, *inter alia*, to the Vaccine Table became effective on March 21, 2017: "XIV. Seasonal influenza vaccine…(D) Guillain-Barré Syndrome 3-42 days (not less than 3 days and not more than 42 days)." National Vaccine Injury Compensation Program: Revisions to the Vaccine Injury Table, 82 Fed. Reg. 6,294 (Jan. 19, 2017) (to be codified at 42 C.F.R. pt. 100).

It is now accepted that influenza vaccine can result in GBS. It is undisputed that petitioner received an influenza vaccine on October 25, 2011. It is undisputed that petitioner was hospitalized on October 27, 2011 and ultimately diagnosed with GBS, albeit an atypical GBS. Thus, prong I, also known as the "can it cause?" inquiry, is satisfied.

B. Logical Sequence of Cause and Effect and Proximate Temporal Relationship

The second *Althen* prong requires proof of a "logical sequence of cause and effect." *Capizzano*, 440 F.3d at 1326 (quoting *Althen*, 418 F.3d at 1278). In other words, even if the vaccinations can cause the injury, petitioner must show "that it did so in [this] particular case." *Hodges v. Sec'y of Health & Human Servs.*, 9 F.3d 958, 962 n.4 (Fed. Cir. 1993) (citation omitted). "A reputable medical or scientific explanation must support this logical sequence of cause and effect," *id.* at 961 (citation omitted), and "treating physicians are likely to be in the best position to determine whether a logical sequence of cause and effect show[s] that the vaccination was the reason for the injury," *Paluck v. Sec'y of Health & Human Servs.*, 786 F.3d 1373, 1385 (Fed. Cir. 2015) (quoting *Andreu*, 569 F.3d at 1375). A petitioner is not, however, required "to eliminate alternative causes as part of establishing [their] prima facie case." *Doe v. Sec'y of Health & Human Servs.*, 601 F.3d 1349, 1357-58 (Fed. Cir. 2010); *see Walther v. Sec'y of Health & Human Servs.*, 485 F.3d 1146, 1152 (Fed. Cir. 2007) (holding that a "petitioner does not bear the burden of eliminating alternative independent potential causes").

The third *Althen* prong requires that petitioner establish a "proximate temporal relationship" between the vaccination and the alleged injury. *Althen*, 418 F.3d at 1281. This "requires preponderant proof that the onset of symptoms occurred within a timeframe for which, given the medical understanding of the disorder's etiology, it is medically acceptable to infer causation-in-fact." *De Bazan v. Sec'y of Health & Human Servs.*, 539 F.3d 1347, 1352 (Fed. Cir. 2008). Typically, "a petitioner's failure to satisfy the proximate temporal relationship prong is due to the fact that onset was too late after the administration of a vaccine for the vaccine to be the cause." *Id.* However, "cases in which onset is too soon" also fail this prong; "in either case, the temporal relationship is not such that it is medically acceptable to conclude that the vaccination and the injury are causally linked." *Id.*; *see also Locane v. Sec'y of Health & Human Servs.*, 685 F.3d 1375, 1381 (Fed. Cir. 2012) ("[If] the illness was present before the vaccine was administered, logically, the vaccine could not have caused the illness.").

The resolution of prongs II and III in this case are so interwoven that they are best addressed together.

The experts agree that petitioner suffered from an atypical form of GBS. The experts disagree on the cause of his GBS, whether his GBS began before his vaccine or within 24 hours after his vaccine, and whether 24 hours is an appropriate time frame for GBS following a flu vaccine. Petitioner's experts submit that petitioner received the flu vaccine on October 25, 2011, and had an onset of GBS symptoms on October 26, 2011, within 24 hours of the vaccine. According to petitioner's experts, petitioner's flu vaccine triggered his atypical GBS, either directly or in combination with an upper respiratory infection ("URI") that petitioner had three to four weeks prior to his flu vaccination; this URI resulted in an aberrant immune response, which was exacerbated by the introduction of the flu vaccination. Tr. 50-53; Pet. Ex. 18 at 2.

Conversely, respondent's expert, Dr. Chaudhry, opined that petitioner's GBS was causally related to the URI petitioner had three to four weeks prior to receiving the flu vaccine, petitioner's onset of GBS was prior to the vaccination, and arguably, even if the onset of petitioner's GBS was found to have been after the vaccination, the URI was the cause and the flu vaccination had nothing

to do with it. Tr. 84; Resp. Ex. A at 1, 6-7; Pet. Ex. 1 at 91, 105.

1. Petitioner had an upper respiratory infection three to four weeks before receiving the influenza vaccine.

According to the hospital record following his flu vaccination, petitioner reported and Dr. Menon noted that petitioner presented "yesterday complaining of weakness…A couple of days ago, he had a [vaccine] for flu….Apparently 3 to 4 weeks ago, he had an upper respiratory infection." Pet. Ex. 3 at 10.

At the hearing, in response to questions regarding his health three to four weeks prior to his vaccination, petitioner stated that he had congestion, which he gets around the same time every year and which is "[m]ore like an allergy." He did not have a fever, sore throat, or cough, and did not go to the doctor. He used Afrin[4] and the congestion went away in a few days. Tr. 113-14, 129. Petitioner contrasted these symptoms to the bronchitis and fever he had in June and August of 2011, for which he saw a doctor and required antibiotics. Tr. 119-20, 127-29, 134. Petitioner conceded that he suffered from frequent nasal congestion and URIs both before and after the influenza vaccination of October 25, 2011. Tr. 123-24. Petitioner added that he had the flu in February of 2012 and a tetanus vaccine on April 16, 2012, neither of which resulted in GBS. Petitioner further testified that he had received the flu vaccine every other year since 2002 without developing GBS. The only time that he experienced numbness or weakness was after the flu vaccine of October 25, 2011. Tr. 125-27.

Dr. Latov noted that Dr. Menon was the only physician who referenced a prior URI, so he did not give much weight to it, believing it to be a misunderstanding. Tr. 28, 35; Pet. Ex. 22 at 2.

According to Dr. Chaudhry, the fact that petitioner recalled and reported having symptoms three to four weeks prior to the vaccine suggested that petitioner had a URI. Tr. 146-48. In his experience, people typically do not remember minor illnesses or minor symptoms, but they remember flu-like symptoms. *Id*. However, Dr. Chaudhry also testified that it is irrelevant whether petitioner complained of nasal congestion or other symptoms three weeks before his flu vaccine because his complaints were still within the realm of a URI. Tr. 172.

In general, I found the petitioner to be genuine in his testimony though somewhat scattered and certainly anxious. I believe that upon his presentation to the emergency room on October 27, 2011, he accurately relayed his medical history as best as he could to the doctors, and out of fear of what was happening to him, provided anything and everything he could remember in response to questions about his health in the weeks preceding the onset of the GBS. I agree with Dr. Chaudhry that petitioner's history included a URI three to four weeks prior to his vaccination, rather than simply congestion from allergies, which would be less memorable.

[4] "Afrin" is the brand name for oxymetazoline hydrochloride, an over the counter nasal spray used to treat nasal congestion due to a cold, hay fever, and upper respiratory allergies. *See oxymetazoline hydrochloride – Drug Summary*, PDR: PRESCRIBERS DIGITAL REFERENCE, http://www.pdr.net/drug-summary/Rhofade-oxymetaoline-hydrochloride-24026 (LAST VISITED FEB. 28, 2018).

2. Did petitioner's symptoms of GBS begin before or after the influenza vaccine?

The confusing onset finds its genesis in notes dictated by physicians who cared for petitioner upon his arrival at the hospital on October 27, 2011. Dr. Jenifer, the emergency room physician, noted on October 27, 2011, that petitioner presented with pain in his shoulder blades ongoing for two days, followed by progressive numbness, tingling of his left arm and left leg, and weakness in his right arm. A recent flu vaccine was noted. Pet. Ex. 3 at 3-4. The discharge summary repeated this history. Pet. Ex. 11 at 271.

Dr. Weisman, the neurologist, wrote that on October 27, 2011, petitioner reported:

> Two mornings ago he awakened with pain in his left arm, the left upper chest, and through to his back and along with this was a feeling of numbness in the arm. This abated. Later in the day he got a flu shot without any incident. Yesterday, he awakened with numb feeling involving the entire left side of his body from the neck down along with a feeling of weakness and today this spread to the right side. He says that he can barely stand or walk and cannot use his arms and hands normally. He describes weakness, numbness, and pain.

Pet Ex. 3 at 12. These records place onset on October 25, 2011, before the flu vaccine. However, the remainder of the records place onset a day later.

Dr. Menon's note dictated on October 28, 2011 states, "Steve…came to the emergency room yesterday complaining of weakness. Apparently two days ago, he woke up with his left side feeling weak, upper and lower extremities and entire left. This gradually improved. Yesterday, he woke up with the entire right side of the body feeling weak. He was unable to stand or walk. He cannot use his arms normally." Pet. Ex. 3 at 10.

Dr. Manneheimer's notes for October 29, 2011 and October 30, 2011 state that petitioner and his fiancée advised that the symptoms developed after his flu vaccine. Pet. Ex. 11 at 13, 21. Dr. Mehta's notes on October 31, 2011 indicated that petitioner had a flu shot and then had an acute onset of weakness and numbness, and to a lesser extent, pain. Pet. Ex. 11 at 23. Dr. Gennaula, who provided a second neurological consult on November 1, 2011, noted that petitioner reported being in his normal state of health until receiving a flu vaccine and waking the following morning with weakness. Pet. Ex. 11 at 15.

Petitioner testified in an effort to clarify the confusion. According to petitioner, he works from 7:30 am to 5:00 pm; he received the vaccine at work around midmorning or early afternoon on October 25, 2011. Tr. 112-13, 119. He stated that he was fine on the morning of the vaccination and did not have any symptoms that morning or he would not have taken the vaccine. Tr. 111-12; 120. Petitioner was insistent that his symptoms did not start until the morning after the vaccine, when he awoke with left sided numbness that "felt like a shot of Novocaine" in his left arm and chest. Tr. 114, 129. He went to work thinking that he "slept wrong" and that it would resolve, but it spread. Tr. 114, 129-30. His co-workers suggested that he may have a pinched nerve. Tr. 121; Pet. Ex. 15 at 1. When he got home, he called his fiancée, who told him to go to the emergency room, but he did not. Tr. 114; Pet. Ex. 15 at 1. When he awoke the following morning, he could

barely stand, and took himself to the hospital. Tr. 114-16; Pet. Ex. 15 at 1. He eventually learned that he had GBS, which his doctors ultimately related to the flu vaccine. Tr. 113-17, 119, 129-31, 133; Pet. Ex. 1-2; Pet. Ex. 15 at 1.

Petitioner was questioned about Dr. Weisman's note. Petitioner stated that he had tried to explain to Dr. Weisman that, a couple of days before the flu vaccination, he had slept wrong on the couch, and awoke with pain in his left arm and chest. When he awoke the day after the vaccination with pain on his left side, he thought it had something to do with his "sleeping wrong" a few days before. Tr. 132. Petitioner stated that he never had numbness until after the vaccine. Tr. 121.

According to petitioner, he never told Dr. Menon that the symptoms he developed after the vaccination improved. Tr. 122, 124. Petitioner agreed that the onset of his symptoms was the morning after the flu vaccine, less than 24 hours after receiving the vaccine. Tr. 119.

Dr. Latov understood Dr. Menon's note dictated on October 28, 2011 which stated that petitioner's symptoms started "two days" before, to mean that petitioner's symptoms began on October 26, 2011, a day after the vaccination. Tr. 32-33. Dr. Latov stated that Dr. Menon used the word "improved" for petitioner's symptoms the day after the vaccination. According to Dr. Latov, Dr. Weisman used the term "abated," which means the symptoms went away entirely. In Dr. Latov's opinion, GBS symptoms do not "abate" they begin and then worsen. Tr. 30-31. He explained that the language used by the two doctors ("abated" vs. "improved") differentiates the two events and the sensory issues (numbness/pain) from weakness. Tr. 70. According to Dr. Latov, symptoms that occur and then improve would be consistent with GBS, because symptoms can fluctuate but cannot completely abate, particularly during the progressive phase of the disease. Pet. Ex. 24 at 1; Tr. 34. Thus, the symptoms prior to the vaccine, which abated, were not GBS-related.

Dr. Latov accepted petitioner's explanation that he had numbness in his arm as a result of sleeping wrong on the couch. Dr. Latov stated that he did not know what was going on with petitioner the morning of the vaccination, but expects that a flu shot would not be given to someone who presented with sensory complaints. Additionally, he expects that petitioner would have gone to the doctor rather than to get a flu shot if he woke up with symptoms of numbness that did not go away. Tr. 79-80.

Dr. Chaudhry disagreed with Dr. Latov's interpretation of the records, stating that when petitioner was admitted on October 27, he complained of weakness occurring on October 25, 2011. Tr. 163-64; Pet. Ex. 1 at 95-96. In Dr. Chaudhry's opinion, records created at the time of presentation would be the most accurate reflection of the onset of petitioner's symptoms because that is when petitioner's memory would be fresh. Tr. 164, 201. According to Dr. Chaudhry, the emergency room and rehabilitation records all reference onset prior to the vaccine.[5] Tr. 201.

Dr. Chaudhry further disagreed with the distinction made by Dr. Latov between "abating" and "improving" symptoms. Tr. 161. According to Dr. Chaudhry, sensory symptoms are due to discharges on the nerves and cause pain and numbness, while motor symptoms cause weakness.

[5] Drs. Manneheimer, Mehta, and Gennaula's records all state that the onset was after the flu vaccination. *See* Pet. Ex. 11 at 13, 15, 21; Pet. Ex. 7 at 10.

In his experience, weakness is more concerning to a patient. Tr. 161. Dr. Chaudhry stated that petitioner's symptoms began before he received the flu vaccine because the symptoms he described were neuropathic and part of GBS. Moreover, fluctuations of symptoms are not uncommon, particularly when a disease process is rapidly evolving. Tr. 85-86, 103-04, 161-62; Resp. Ex. I at 1-2. Dr. Chaudhry added that petitioner's description of both events involved the left side, meaning they were connected, and therefore the onset of GBS was before the flu vaccine. Tr. 91, 102. Therefore, it is logical to connect petitioner's initial left arm numbness which abated to his later left side numbness. Tr. 162-63.

According to Dr. Chaudhry, it does not matter whether petitioner had symptoms at the time of the flu vaccine because the URI three to four weeks prior was the more likely cause of his GBS. Tr. 162.

Petitioner's attempt to distinguish the two events at hearing was hampered by his inability to accurately and descriptively articulate his symptoms. Additionally, what petitioner may have thought his descriptive terms meant clearly had different meanings to his physicians. However, I understood petitioner's testimony to be that he tried to explain to Dr. Weisman that he had "slept wrong" on the couch at some point prior to his flu vaccine, and when he awoke he had pain and numbness in his left arm, left chest, and mid-back that went away. The morning after the flu vaccination, he awoke with left-sided pain, numbness, and weakness that became worse over that day, and by the following morning had spread to the right side. While I doubt that petitioner would have received a vaccine if he thought there were something seriously wrong with him, I do believe that the symptoms on his left side that he attributed to sleeping wrong were pain and numbness, not weakness, and that by the time he presented for the vaccine, those symptoms had gone away.

Dr. Latov pointed out, as did Dr. Weisman, Dr. Menon, and Dr. Mehta in their records, and petitioner confirmed, the difference between petitioner's descriptions of the two events was the complaint of weakness after the vaccination, which was not mentioned in his description of symptoms before the vaccination. Moreover, it is clear that it was not until after petitioner received the flu vaccination that he had a rapid onset of GBS-like symptoms on his entire left side which spread to the right with weakness and numbness. Based on petitioner's testimony in which he differentiated his shoulder, chest, and mid-back pain from "sleeping wrong" on the couch versus the weakness and numbness that he experienced after the flu vaccination, supported by Dr. Latov's testimony clarifying sensory issues versus weakness, I find by a preponderance of the evidence that petitioner's symptoms of GBS began after he received the flu vaccine, when he experienced weakness for the first time.

3. GBS can, on very rare occasions, have an onset within 24 hours.

The experts agree that this petitioner had an atypical GBS, but they disagreed on the time of onset of his GBS due to the unusual results of his two EMG/NCS studies and the lumbar puncture, in addition to the foregoing discrepancies in the record. In Dr. Morgan's opinion, petitioner's GBS started within two days of the vaccine and reached its nadir by October 28, 2011, as indicated by the elevated CSF protein and abnormal nerve conductions/EMG studies on November 2, 2011, which were indicative of AIDP. Pet. Ex. 16 at 7.

According to Dr. Latov, petitioner's EMG and lumbar puncture results were unusual but can be explained, and do not exclude a possible onset within 24 hours of vaccination. While Dr. Chaudhry admitted that he has seen GBS symptoms appear within 24 hours, in his opinion, petitioner's results on the EMG/NCS studies and the lumbar puncture placed the onset of his GBS symptoms before he received the influenza vaccine. Tr. 88.

a. GBS and EMG/NCS studies

All the experts agreed that diagnosing GBS requires electrodiagnostic testing. Nerve conduction studies ("NCS") distinguish between the two major types of peripheral neuropathy – axonal degeneration and demyelination. Electromyography ("EMG") testing provides additional diagnostic information, done in tandem with the NCS. The EMG is an electrical recording of the activity in a muscle, made by inserting a needle electrode into the muscle. A cross section of the muscle contains hundreds of muscle fibers in one motor unit; the needle will only pick up about four to six of these fibers. An analysis of the waveforms and firing rates of a motor unit or units provides diagnostic information. Skilled electromyographers interpret both appearance of the muscle and the sound of muscle activity transmitted through a loudspeaker. A normal resting muscle is silent. Pet. Ex. 22H[6] at 2, 4.

The primary cause of weakness in cases of acute inflammatory demyelinating polyneuropathy ("AIDP"), a form of GBS and what petitioner was diagnosed with, is "conduction block." Pet. Ex. 22H at 4. When conduction block is present, the EMG shows a reduced pattern of motor units of normal appearance. *Id*. If there has been a secondary axonal degeneration, as in acute motor axonal neuropathy ("AMAN"), the rarer axonal form of GBS, the EMG shows fibrillations indicating axonal loss. *Id*. In the evolution of GBS, finding signs of axonal loss implies a poorer prognosis for recovery. *Id*.

Dr. Chaudhry explained that the NCS study is divided into three parts: the motor nerve conduction study, the sensory nerve conduction study, and the F wave. Tr. 136-37. The first number is the "latency measure," or the time it takes for an electrical impulse to travel from the nerves to the corresponding muscle. The second number measures the level of muscle response to the electrical impulse. The third number is the "conduction velocity," or how fast the nerves are conducting. The F wave measures how fast the nerves conduct more proximally, such as to the neck and lower back muscles; sometimes the F wave shows abnormalities earlier than the other measurements. Tr. 138-39.

Dr. Latov added that a nerve is like a wire that conducts electricity; the axon is the "core" of the wire, and the myelin sheath is the insulation. Tr. 12. If the myelin sheath is damaged, the signal is not transmitted as rapidly, and the EMG will show conduction slowing. Tr. 12. If the axon, or the "core" part of the wire, is damaged, the EMG will show decreased amplitude. Tr. 12. The muscle is "innervated" by the nerve – the nerve stimulates the muscle to contract. Tr. 12. If the muscle loses innervation and is no longer regulated by the nerve, it will contract spontaneously and produce denervation potential. Tr. 13. The likelihood of denervation and the level of weakness

[6] K.R. Mills, *The basics of electromyography*, 76 J NEUROL NEUROSURG PSYCHIATRY Suppl II: ii32-ii35 (2005), filed as Pet. Ex. 22H.

depend on the level of damage to the axon. Tr. 13.

Dr. Chaudhry discussed petitioner's first EMG/NCS study which was done on October 30, 2011, four or five days after petitioner's symptoms began, depending on which onset date is accepted. Tr. 137; Pet. Ex. 1 at 87; Pet. Ex. 11 at 12. The latency measure was normal; with a demyelinating disease such as GBS, the latency measure should have been higher because the demyelination would cause nerve damage, increasing the travel time for the electrical impulse. Tr. 138. Petitioner also had normal measures for the muscle response, conduction velocity, and F wave tests. Tr. 138. Petitioner's EMG was described as unremarkable, but Dr. Chaudhry added that the testing was done on petitioner's right side, rather than his left side, where the symptoms started. Tr. 137-38, 140.

Dr. Chaudhry then discussed the EMG/NCS study of November 2, 2011, which tested both petitioner's right and left sides, and was abnormal. Tr. 141; Pet. Ex. 1 at 76. This test showed an increased latency measure, a decreased conduction velocity, and a decreased muscle response; additionally, the F wave was abnormal. Dr. Kirby, the electromyographer, noted that these findings were consistent with an evolving demyelinating neuropathy. Tr. 141.

According to Dr. Chaudhry, petitioner had an atypical form of GBS because his presentation did not fit AIDP or AMAN. Petitioner's EMG/NCS study showed fibrillations, which typically are not seen in the first week or two in AIDP, but there was a suggestion of axonal loss, which is indicative of AMAN. He also did not have conduction block, which is typical of AIDP. Dr. Chaudhry was pressed for his opinion and stated that, given the results, he would lean toward a diagnosis of AIDP. Tr. 191.

Dr. Latov explained that GBS initially involves evidence of demyelination in the forms of conduction slowing and reduced secondary axonal involvement. Then, Wallerian degeneration[7] occurs, which means that the segment of the nerve that innervates, or stimulates the muscle, degenerates. After a few days, there is evidence of denervation,[8] which happens when the muscle loses its nerve input and discharges spontaneously. Denervation normally takes two to four weeks to develop, depending on the distance between the lesion and the muscle; in animals and some humans, that could be five to seven days. In most humans, the lesion is further away from the muscle and denervation will take several weeks to be seen. Tr. 9-10. However, denervation in mice and rats can appear in as little as two days due to the short distance between the lesion and the muscle. Tr. 11, 14. Therefore, the nerve injury can occur quickly if the distance between the muscle and the nerve is shorter. Tr. 14.

Dr. Chaudhry disagreed with Dr. Latov's opinion on Wallerian degeneration, stating that in humans it takes seven to ten days for Wallerian degeneration to show up on an NCS and at least two weeks for changes to appear on an EMG. Tr. 142. According to Dr. Chaudhry, the November 2, 2011 study showed a substantial change in three days from the test results of October 30, 2011,

[7] Wallerian degeneration is the process that results when a nerve fiber is cut or crushed and the part of the axon distal to the injury degenerates. *Dorland's* at 481.

[8] Denervation is the interruption of the nerve connection to an organ or part. *See Stedman's Pocket Medical Dictionary* 192 (1st ed. 1987).

which suggests an onset of injury prior to petitioner's receipt of the influenza vaccine; he estimated an onset around October 18, 2011. However, Dr. Chaudhry admitted that petitioner could be the one to two percent of patients who have acute changes early on. Tr. 145; Pet. Ex. 1 at 75-76; Pet. Ex. 10 at 40-44; Resp. Ex. H.[9] Dr. Chaudhry agreed that, because GBS is a developing process, it is possible to have a normal EMG one day and then an abnormal EMG a few days later; while these results were uncommon, they were not unheard of. Tr. 89, 168. However, this possibility did not change his opinion on onset in this case. Tr. 168.

Dr. Latov agreed with Dr. Chaudhry that it usually takes 10 to 12 weeks for symptoms to fully evolve, and it was unusual to see changes on the EMG on November 2, 2011, seven days after petitioner's symptoms began. Tr. 10-11. However, Dr. Latov pointed out that 10 to 11 weeks later, when the EMG was repeated and should have shown maximal changes, it was normal. Tr. 11. In Dr. Latov's opinion, either the EMG was inaccurate, or the lesion was very close to the muscle and petitioner recovered quickly. Tr. 11, 14.

b. Cerebrospinal Fluid Testing

According to the experts, the second test for GBS is testing of the cerebrospinal fluid ("CSF"), done through a lumbar puncture. According to Dr. Latov, in patients with GBS, a lumbar puncture typically shows a normal CSF white cell count with increased protein levels; this is what distinguishes GBS from infectious diseases. Tr. 8; Resp. Ex. E[10] at 1. Inflammation causes the nerves to leak protein and albumin into the spinal fluid, which elevates the proteins in the CSF. Central nervous system diseases elevate CSF protein as well. Tr. 16. Therefore, elevated CSF protein levels indicate an inflammatory condition of the nerves. Tr. 16. However, anything that disrupts the blood-brain barrier will elevate CSF protein. Tr. 16. Petitioner had a CSF protein level of 55; normal is 45. Tr. 8.

As further support for his opinion that petitioner's GBS began before his flu vaccine, Dr. Chaudhry stated that the elevation of petitioner's CSF protein on the third day after vaccination, was unusual; generally CSF protein levels do not reach abnormal levels until the second week after onset of GBS. Tr. 168. While CSF protein levels are often normal in the first week, 90% of patients will have increased CSF protein by the end of the second week. Resp. Ex. E at 1. Dr. Chaudhry agreed that 10% of the people can have elevated CSF protein early on, but it is still unusual to see it within the first week. Tr. 168.

Dr. Latov stated that elevated CSF protein can occur within two days of illness, pointing to the Ropper study, which showed 18 patients, or 16%, had elevated CSF protein levels within two days. Tr. 25-26; Pet. Ex. 22M[11] at 155. Dr. Latov also relied on Pet. Ex. 16B, a Dutch study,

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[9] *Electromyography and Neuromuscular Disorders: Clinical-Electrophysiologic Correlations* 237-38 (Preston & Shapiro eds., 2nd ed.), filed as "Resp. Ex. H."

[10] P. A. van Doorn et al., *Clinical features, pathogenesis, and treatment of Guillain-Barre syndrome*, 7 LANCET NEUROL 939-50 (2008), filed as "Resp. Ex. E."

[11] *Guillain-Barre Syndrome: Spinal Fluid and Other Laboratory Findings* 155-60 (Ropper, Wijdicks, & Truax eds., 1st ed. 1991), filed as "Pet. Ex. 22M."

which showed elevated CSF protein levels in 50% of the patients in the first week and 80% in the second week. Therefore, according to Dr. Latov, the sensitivity of the test is not very high, particularly not in the first week. Pet. Ex. 16B[12] at 5.

This case was complicated by the quick onset of weakness, and the question of whether petitioner's symptoms began before or after the influenza vaccine. It was also complicated by petitioner's atypical presentation and test results. Where petitioner's test results should have been negative, they were positive, convincing Dr. Chaudhry that the onset was earlier than petitioner claimed. Conversely, where the test results should have been at their most definitive, they were back to normal, further convincing Dr. Chaudhry that the onset was earlier than the vaccination. Typically, onset of GBS is between 3 and 42 days. However, as the experts agreed, there are outliers that can occur as early as within 24 hours. The combination of the facts of this case and the opinions expressed by the experts provide reasonable and logical evidence that petitioner had an abrupt onset of atypical GBS within 24 hours of his flu vaccine.

4. The combination of an upper respiratory infection three to four weeks before the receipt of the influenza vaccine would account for the rapid onset and acceleration of GBS symptoms within 24 hours of the vaccination.

According to Dr. Morgan, if one accepts that petitioner had an initial evolving post-infectious GBS from a prior URI, then the GBS process would have been initially mild, with primarily sensory and pain complaints. Accepting Dr. Weisman's statements, those mild GBS symptoms "abated prior to the flu shot." Pet. Ex. 18 at 2. However, fewer than 24 hours later, petitioner was exposed to a "subsequent immune challenge" in the form of the flu shot, which caused "upregulation of the immune system," resulting in the early onset of GBS symptoms. *Id*. In Dr. Morgan's opinion, petitioner had an ongoing aberrant immune response, which was exacerbated by the introduction of the flu shot and resulted in a more severe form of GBS. *Id*.; Pet. Ex. 1 at 104-05; *see generally* Pet. Ex. 18B.[13]

Dr. Morgan pointed out that this process would be consistent with the "co-infection" hypothesis for both post-infectious and post-vaccinal polyneuropathies. Pet. Ex. 18 at 2; Pet. Ex. 18C;[14] Pet. Ex. 22P[15] at 6. The cross reactivity of the dual antigens, in this case the flu vaccine and the URI, to the myelinated peripheral nerve fibers caused petitioner's atypical GBS, which is why petitioner had an early onset of GBS symptoms following the flu shot. Pet. Ex. 18 at 2-3. Dr. Morgan pointed out that the IOM suggests that subsequent exposure to an immune challenge

[12] F.G.A. Van der Meche et al., *Diagnostic and classification criteria for the Guillain-Barre Syndrome*, 45 EUROPEAN NEUROLOGY 3: 133-39 (2001), filed as "Pet. Ex. 16B."

[13] *Post-infectious Syndromes,* CONTINUUM: LIFELONG LEARNING IN NEUROLOGY, 8(3): 92 (2002), filed as "Pet. Ex. 18B."

[14] F.C. Westal and R. Root-Berstein, *Cause and prevention of postvaccinal neuropathies in light of a new theory of autoimmunity*, 2 LANCET 8501: 251-52 (1986), filed as "Pet. Ex. 18C."

[15] I. Steiner et al., *Transient immunosuppression: a bridge between infection and the atypical autoimmunity of Guillain-Barre syndrome?*, 162 CLIN EXP IMMUNOL 1: 32-40 (2010), filed as "Pet. Ex. 22P."

results in a shorter onset, for a secondary immune response of one to three days. Pet. Ex. 18 at 4; *see also* p. 22, n.29; Pet. Ex. 18D.[16]

According to the literature submitted by petitioner in support of the "co-infection" theory, "GBS is a disorder that develops in the context of immune deficiency or otherwise altered immune function…. [T]he immune compromised state can be due to a transient factor such as an infection with a pathogen capable of manipulating the immune response." Pet. Ex. 22P at 6. GBS has been reported in patients with a variety of conditions. *Id*. at 7. Scientists have also postulated that GBS is due to co-infection. *Id*. In this theory, the first pathogen induces a breakdown of immune tolerance, while the other elicits an immune-mediated attack on peripheral nerve antigens. *Id*.; s*ee also* Pet. Ex. 18B at 4.

According to Dr. Latov, the flu vaccine triggered the petitioner's GBS, whether directly or in combination with the URI three to four weeks prior to the vaccination. Tr. 50-53. Even if petitioner had an onset of GBS prior to his vaccination, the vaccine was capable of exacerbating whatever ongoing process he had by boosting the immune system and causing the autoimmune reaction to be stronger.[17] Tr. 77-78. Dr. Latov explained that the URI could have acted synergistically with the influenza vaccine to cause development of immunity to a cross-reactive epitope or bystander activation. Tr. 36; Pet. Ex. 24 at 2. According to Dr. Latov, the literature supports that infection or immunization might induce GBS, and an understanding of the underlying mechanism supports the theory that a combination of vaccination and preceding infection can be more effective in triggering a neuropathy than either one alone. Pet. Ex. 22 at 2; *see also* Pet Ex. 22P at 7 ("…the possibility that GBS is due to co-infection may also be postulated: the first pathogen may induce breakdown of immune tolerance while the other can elicit an immune-mediated attack on peripheral nerve antigens").

Dr. Latov submitted additional studies to show that infection can cause transient immunosuppression, which can weaken immune tolerance. The concurrence of immunosuppression with immune stimulation facilitates activation of autoreactive cells and occurrence of autoimmune disease. Pet. Ex. 22 at 2; *see also* Pet. Ex. 22P; Pet. Ex. 22D.[18] In Pet. Ex. 22G,[19] it was reported that a combination of influenza vaccine and nerve antigen was significantly more effective in inducing GBS in experimental rats than the nerve antigen alone. In

[16] K. Stratton et al., ed., ADVERSE EFFECTS OF VACCINES: EVIDENCE AND CAUSALITY, pp. 51-52 (2012) ["2012 IOM Report"], filed as Pet. Ex. 18D.

[17] Dr. Latov pointed to article on MS increasing eightfold following receipt of the *haemophilus influenzae b* vaccine as an example of a vaccine exacerbating a disease. Tr. 78.

[18] P. Deepak et al., *Neurological events with tumour necrosis factor alpha inhibitors reported to the Food and Drug Administration Adverse Event Reporting System*, 38 ALIMENT PHARMACOL THER 388-96 (2013), filed as Pet. Ex. 22D.

[19] R. Hjorth et al., *Experimental Neuritis Induced by a Mixture of Neural Antigens and Influenza Vaccines*, 6 J NEUROIMMUNOL 1: 1-8 (1984), filed as Pet. Ex. 22G.

Pet. Ex. 22S,[20] *campylobacter jejuni* lipopolysaccharides[21] were administered to animals previously immunized with keyhole limpet hemocyanin,[22] resulting in a generation of anti-ganglioside autoantibodies and neuropathy. In Dr. Latov's opinion, these studies support the theory that the combination of an immunogen and an infectious agent appears to deliver multiple immunostimulatory signals that overcome tolerance to cause autoimmune disease. Pet. Ex. 22 at 2. According to Dr. Latov, this theory explains how the URI and the flu vaccine could act together synergistically and cause petitioner to develop GBS. Tr. 45-46.

Dr. Latov acknowledged that, while GBS following influenza vaccine is now on the Vaccine Injury Table, the Federal Register specifically states that onset is within 3 to 42 days. TR. 63. Further, onset of GBS in less than 3 days or 72 hours after the vaccine excludes the vaccine as the cause based on the immunological steps necessary to create symptomatic disease, which requires a minimum of three days. Tr. 63-64. Dr. Latov submitted that the onset period contained on the Table was determined by a committee, with varying opinions as to onset, so the 3 to 42 day onset period was likely a compromise. Tr. 64.

Dr. Latov explained that the average onset of GBS takes longer than a day after vaccination. However, immune memory, can result in faster onset. Tr. 17. If he had preexisting cells which were reactive in his peripheral nerves, then one day would be sufficient. *Id.*

According to Dr. Latov, data supports an immune response developing very quickly. Tr. 64. Dr. Latov relied on the Schonberger article.[23] Dr. Latov pointed out that this was a 1976-1977 swine flu vaccine study, with a higher incidence of GBS in patients presenting as early as one to two days and up to 12 weeks after vaccination. Tr. 18, 20. 71% of patients experienced onset within the first four weeks after vaccination, with 52% citing an onset during weeks two and three. The largest percentage of cases (10%) experienced onset between 16 and 17 days after vaccination. Tr. 18-19; Pet. Ex. 22N[24] at 7-8. While Dr. Latov pointed out that Figure 5 shows that 11 participants in the study reported an onset of GBS occurring within zero to one day of vaccination, he agreed that the article did not conclude that onset could occur between zero and one day. Tr. 20-22; Pet.

[20] I. Wirguin et al., *Induction of anti-GM1 ganglioside antibodies by* Campylobacter jejuni *lipopolysaccharides*, 78 J NEUROIMMUNOL 138-42 (1997), filed as Pet. Ex. 22S.

[21] *Campylobacter jejuni* is a bacterium associated with the development of AMAN, a form of GBS. Pet. Ex. 22S at 2.

[22] Keyhole limpet hemocyanin (KLH) is a commonly used antigen in laboratory immunology. *See Dorland's Illustrated Medical Dictionary* 839 (32nd ed. 2012), hereinafter "Dorland's."

[23] Although this decision discusses many but not all of the literature in detail which was submitted by the parties, the undersigned reviewed and considered all of the medical records and literature submitted in this matter. *See Moriarty ex rel. Moriarty v. Sec'y of Health & Human Servs.*, 844 F.3d 1322, 1328 (Fed. Cir. 2016) ("We generally presume that a special master considered the relevant record evidence even though [s]he does not explicitly reference such evidence in h[er] decision."); *Simanski v. Sec'y of Health & Human Servs.*, 115 Fed. Cl. 407, 436 (2014) ("[A] Special Master is 'not required to discuss every piece of evidence or testimony in her decision.'" (citation omitted)), *aff'd*, 601 F. App'x 982 (Fed. Cir. 2015).

[24] L. Schonberger et al., *Guillain-Barre syndrome following vaccination in the National Influenza Immunization Program, United States, 1976-1977*, 110 AM J EPIDEMIOL 2: 105-23 (1979), filed as "Pet. Ex. 22N."

Ex. 22N at 112. Rather, the article concluded that the peak period when participants reported onset of GBS was two to three weeks after vaccination. However, he also pointed out that Figure 5 showed a greater incidence of onset in the first day than on the 41st day. This confirms the potential for an onset of one day and supports a higher incidence of GBS earlier rather than later; after 41 days, the incidence recedes. Tr. 57, 72-73. Dr. Latov agreed that recent studies show the risk of developing GBS after the influenza vaccine is highest during weeks two through four. Pet. Ex. 31[25] at 2.

Dr. Latov further elaborated on Dr. Morgan's co-infection theory, submitting a report supporting a shortened response time with re-exposure to an antigen. Tr. 23; Pet. Ex. 29[26] at 5. According to the IOM, after exposure to an antigen, two types of lymphocytes, B cells and T cells, will differentiate into effector cells and memory cells. Pet. Ex. 29 at 4. The time between the first exposure to the antigen and the development of the primary response is known as "latency." *Id*. at 5. Latency has three stages: the lag phase, the logarithmic phase, and the plateau phase. *Id*. Memory B and T cells develop during the primary immune response; therefore, upon subsequent exposure to the antigen, the immune cells "remember" the antigen. *Id*. This results in a shorter latency period between exposure and immune response. *Id*. After re-exposure to an antigen, the lag phase is generally one to three days; the logarithmic phase of the secondary antibody response occurs over the next three to five days.[27] *Id*.

Dr. Latov referenced PPD tuberculin skin test as an example of a shortened latency period following re-exposure to an antigen; a patient who is "pre-sensitized" to PPD can have an immediate response within a day.[28] Tr. 24. When questioned about the 24 hour onset in this case, Dr. Latov responded that where there is immunological memory, the response time is immediate. If there are antibodies circulating which can hone in on a nerve, the response could be immediate. Tr. 60.

On cross-examination, Dr. Latov agreed that the IOM report, Pet. Ex. 29, stated that the lag phase is generally one to three days and the logarithmic phase occurs over the next three to five days, suggesting an onset period of four to eight days. Tr. 62. Dr. Latov noted that a

[25] J. Kwong et al., *Risk of Guillain-Barre syndrome after seasonal influenza vaccination and influenza health-care encounters: a self-controlled study*, 13 LANCET 769-76 (2013), filed as "Pet. Ex. 31."

[26] K. Stratton et al., ed., ADVERSE EFFECTS OF VACCINES: EVIDENCE AND CAUSALITY, pp. 57-58 (2012) ["2012 IOM Report"], filed as Pet. Ex. 29.

[27] The lag phase is characterized by the initial activation of B and T cells upon an encounter with the antigen for which they are specific; this triggers the cells' differentiation into effector and memory cells. The lag phase between primary exposure to an antigen and the logarithmic phase is classically thought to be 4 to 7 days, but varies depending on route of exposure and the antigen itself. For B cells, the logarithmic phase is characterized by an increase in the serum antibody levels that classically is logarithmic. The plateau phase is characterized by the maintenance of peak antibody levels for a length of time that is followed by a decline in the serum antibody levels. For many antigens, the latency (lag phase) between primary exposure and development of the primary antibody response is 7 to 10 days. Pet. Ex. 29 at 5.

[28] Petitioner did not submit any medical literature to support this statement; Dr. Latov first mentioned this possibility during the entitlement hearing.

logarithmic phase may be unnecessary; if there is a sufficient number of memory B and T cells in existence at the time of re-exposure, an immune response could be seen immediately. Tr. 62. Dr. Latov stated that the influenza vaccine can stimulate the immune system, and if someone is "susceptible," the development of GBS would be quick. Tr. 48-49. Therefore, infection followed by immunization is more likely to induce GBS then either one alone. Tr. 66, Pet. Ex. 24 at 2. Dr. Latov stated that he relied on the DiGenova article,[29] which discusses autoimmune diseases being exacerbated by immunization. Tr. 66-67; Pet. Ex. 30.

Dr. Latov submitted for purposes of argument that if petitioner's GBS began before the flu vaccine, stimulation of the immune system by vaccination likely caused exacerbation or re-activation of the GBS as can be seen in other autoimmune diseases. Pet. Ex. 22 at 2; *see also* Pet. Ex. 22K[30]; Pet. Ex. 22E[31]; Pet. Ex. 22Q[32] (reporting that, of 31 patients with juvenile idiopathic arthritis, 35% had a flare up following receipt of the flu vaccine). Exacerbation of GBS by vaccination might also result from increased permeability of the blood-nerve barrier due to inflammation or increased secretion of cytokines. Pet. Ex. 22 at 3. Dr. Latov stated that evidence shows inflammatory cytokines such as TNF alpha, IFN gamma, IL-6, and IL-1 beta increase the permeability of the blood nerve barrier. *Id*.; *see also* Pet. Ex. 22C;[33] Pet. Ex. 22R;[34] Pet. Ex. 22T.[35] Induction of pro-inflammatory cytokines has been reported to follow vaccination for influenza (Pet. Ex. 22I;[36] Pet. Ex. 22J[37]) human papillomavirus (Pet. Ex. 22F[38]) and smallpox (Pet. Ex.

[29] G. Di Genova at al., *Bystander stimulation of activated CD4$^+$ T cells of unrelated specificity following a booster vaccination with tetanus toxoid*, 40 EUR J IMMUNOL 976-85 (2010), filed as "Pet. Ex. 30."

[30] S. Pasoto et al., *Short and long-term effects of pandemic unadjuvanted influenza A (H1N1)pdm09 vaccine on clinical manifestations and autoantibody profile in primary Sjogren's syndrome*, 31 VACCINE 1793-98 (2013), filed as "Pet. Ex. 22K."

[31] M. Farez and J. Correale, *Yellow Fever Vaccination and Increased Relapse Rate in Travelers with Multiple Sclerosis*, 68 ARCH NEUROL 10: 1267-71 (2011), filed as "Pet. Ex. 22E."

[32] N. Toplak et al., *Safety and efficacy of influenza vaccination in a prospective longitudinal study of 31 children with juvenile idiopathic arthritis*, 30 CLIN EXP RHEUMATOL 436-44 (2012), filed as "Pet. Ex. 22Q."

[33] H. de Vries et al., *The influence of cytokines on the integrity of the blood-brain barrier in vitro*, 64 J NEUROIMMUNOL 1: 37-43 (1996), filed as "Pet. Ex. 22C."

[34] N. Tsao et al., *Tumour necrosis factor-α causes an increase in blood-brain barrier permeability during sepsis*, 50 J MED MICROBIOL 812-21 (2001), filed as "Pet. Ex. 22R."

[35] D. Wong et al., *Cytokines, nitric oxide, and cGMP modulate the permeability of an in vitro model of the human blood-brain barrier*, 190 EXP NEUROL 446-55 (2004), filed as "Pet. Ex. 22T."

[36] S. Mohanty et al., *Prolonged Proinflammatory Cytokine Production in Monocytes Modulated by Interleukin 10 After Influenza Vaccination in Older Adults*, 211 J INFECT DIS 7: 1174-84 (2014), filed as "Pet. Ex. 22I."

[37] W. O'Gorman et al., *The Split Virus Influenza Vaccine rapidly activates immune cells through Fcgamma receptors*, 32 VACCINE 5989-97 (2014), filed as "Pet. Ex. 22J."

[38] D. Herrin et al., *Comparison of adaptive and innate immune responses induced by licensed vaccines for Human Papillomavirus*, 10 HUM VACCIN IMMUNOTHER 12: 3446-54 (2014), filed as "Pet. Ex. 22F."

22O[39]) vaccines. *Id*. According to Dr. Latov, increased permeability of the blood-nerve barrier following vaccination would allow more autoreactive antibodies, or T-cells, as well as complement components and cytokines to enter the neural compartment, resulting in more severe nerve damage. *Id.*

While Dr. Chaudhry did not believe that the flu vaccine was in any way associated with petitioner's GBS, he did agree that, though rare, GBS can occur within 24 hours. Tr. 88. He stated that, according to Schonberger and Figure 5, 2% of patients suffered onset of GBS between zero and one day after vaccination, but these cases are outliers. Tr. 168-69. Dr. Chaudhry pointed out that Schonberger was a retrospective study on when symptoms began, not when they peaked. The question was how soon after an infection or flu vaccine do symptoms occur, not when symptoms peak; they are two different things. Symptoms may occur fairly quickly after a flu vaccine, but they need time to evolve; here, petitioner's symptoms had an abrupt onset. In the Schonberger study, participants may have had the onset of tingling and numbness in the zero to one day interval, but not paralysis. Dr. Chaudhry explained that the onset of symptoms may be the pain and numbness in the left arm, but the peak would be the paralysis. Additionally, the Schonberger study focused on the swine flu vaccine and did not address causation. Tr. 104-07. Dr. Chaudhry contrasted this with petitioner's presentation, pointing out that petitioner's GBS peaked the day after he received the flu vaccine, when he had weakness and could not stand up. Tr. 105-06. Dr. Chaudhry noted that the Federal Register referenced the Schonberger article in discussing the onset period for the Table; he submitted that, if the committee had considered the zero to one day onset to be important, they would have included that on the Table. Tr. 107. He also pointed out that, prior to the Table change, the Institute of Medicine reviewed the Schonberger article and concluded that there was no causal relationship between the influenza vaccine and GBS. *Id*. The Schonberger article involved the swine flu vaccine and was therefore not precisely on point for determining onset in this case. However, it did allow for onset of a demyelinating autoimmune disease as early as 24 hours.

According to Dr. Chaudhry, petitioner's GBS was caused by the URI three to four weeks prior, not the influenza vaccine. Tr. 172. He noted that most people report an infection three to four weeks prior to presenting with GBS. Tr. 99. Dr. Chaudhry suggested that the URI petitioner had in August could have been responsible, representing the other end of the onset spectrum for GBS, because it occurred ten weeks before petitioner's symptoms. Tr. 173. When asked whether ten weeks was too long an onset period for GBS, Dr. Chaudhry responded that, just like the early onset, there will be the outliers on the opposite ends of the bell curve. Tr. 173. However, Dr. Chaudhry agreed that eight weeks is long but within the spectrum, though he admitted that three to four weeks prior makes more sense to him. Tr. 173. He added, however, that the duration of the August URI had to be considered; the post-infectious GBS process would not start until the original infection had resolved. Tr. 174. Petitioner was prescribed a Z-pack in August, but we do not know whether it worked right away or whether it took a week. Tr. 174. Additionally, petitioner had had a lingering cough since June of 2011. Tr. 174. Dr. Chaudhry conceded that two months is not typical for onset of GBS, but added that nothing in this case is typical. Tr. 175.

[39] W. Simon et al., *Cytokine production associated with smallpox vaccine responses*, 6 IMMUNOTHERAPY 10: 1097-1112 (2014), filed as "Pet. Ex. 22O."

Dr. Chaudhry disagreed with Dr. Morgan's co-infection theory, stating that Dr. Morgan relied upon a 29-year-old paper to support the theory.[40] Resp. Ex. D at 2. The hypothesis was proposed in 1986 and has never been tested or proven. *Id*.

Petitioner's experts, Dr. Latov and Dr. Morgan, provided a well-supported explanation of how petitioner's upper respiratory infection could act synergistically with the influenza vaccine, resulting in a rapid onset of GBS. Petitioner's immune system was already activated due to the URI; the flu vaccine was a subsequent immune challenge which "boosted" the immune response. The flu vaccine induced proinflammatory cytokines, and increased the upregulation of the immune system. The URI caused petitioner's immune system to be "pre-sensitized" to antigen exposure; when the flu vaccine was introduced, petitioner had an immediate antibody response and a rapid onset of GBS symptoms.

The experts in this case were equally impressive. However, Dr. Chaudhry made it clear that despite the Table change to include GBS following flu vaccine, he does not believe that influenza vaccine can cause GBS. He agreed that *campylobacter jejuni* can cause AMAN due to molecular mimicry, but does not agree that molecular mimicry exists for influenza vaccine and GBS. Tr. 95-97. He maintained that the URI was the cause of the GBS and therefore he did not have to entertain any other causative theories. Tr. 94-97, 197; Resp. Ex. D at 2-3; Resp. Ex. G. He further maintained that the URI caused the GBS, which began prior to the vaccine, and therefore the influenza vaccine played no role. Tr. 161-63. He stated that even if there were a longer gap between the vaccine and the onset of the GBS, he would still not give it the sole role. Tr. 199.

I must analyze this case in terms of *Shyface v. Sec'y of Health & Human Services*, in which Cheyenne Shyface was vaccinated with whole-cell DPT at the time he was beginning an *E. coli* infection. Both the DPT and the *E. coli* infection could and did cause fever, which rose to 110 degrees, resulting in his death four days later. 165 F.3d. at 1345. Respondent defended the case and argued that the *E. coli* infection was the cause of the baby's fever and death. Testimony from Cheyenne's treating physician was that both the vaccine and the infection were equally responsible for his fever and death. The Federal Circuit held that each of the two factors, the vaccine and the infection, was a substantial factor in causing the baby's very high fever and death and but for the vaccination, the baby would not have had the high fever and would not have died. The Federal Circuit ruled in favor of petitioners even though petitioners did not prove that DPT vaccine was the only or predominant cause of death. *Id*. at 1353.

Similarly, the petitioner here suffered from a URI shortly before receiving his flu vaccination. Drs. Latov and Morgan explained that the combination of the vaccination and preceding infection caused an aberrant response or acted in a synergistic manner, and was therefore more effective in triggering a neuropathy than either one alone. Tr. 36-40, 45-46; Pet. Ex. 18 at 2; Pet. Ex. 18B; Pet Ex. 22 at 2; Pet. Ex 22P; Pet. Ex. 24 at 2. It is probable that the combination of the URI and the flu vaccine resulted in an upregulation of petitioner's immune system and led to his rapid onset of GBS symptoms within 24 hours of receiving the flu vaccine. Even Dr. Chaudhry agreed that the onset of petitioner's GBS was so abrupt and atypical that his doctors were unclear of his initial diagnosis and considered a variety of possibilities, including stroke, multiple sclerosis,

[40] Dr. Chaudhry and Dr. Morgan are referencing Pet. Ex. 18C.

transverse myelitis, and electrolyte imbalance, but did not consider GBS. Tr. 86-87. Based on the foregoing, I find that petitioner's flu vaccination was a substantial factor in his development of GBS.

Petitioner has satisfied prongs II and III.

C. Burden Shifting: Respondent Must Show an Alternative Cause of Injury

A petitioner who satisfies all three prongs of the *Althen* test has established a prima facie showing of causation. *Hammitt v. Sec'y of Health & Human Servs*., 98 Fed. Cl. 719 (2011). Consequently, the burden now shifts to the government to prove that an alternative cause, unrelated to the administration of the vaccine, was the "sole substantial factor" in causing the alleged injury. *De Bazan*, 539 F.3d at 1354; *see also Hammitt*, 98 Fed. Cl. at 726 (explaining that respondent's burden is to show that the "factor unrelated" was the "sole substantial factor" in causing the injury). Additionally, a factor unrelated "may not include 'any idiopathic, unexplained, unknown, hypothetical, or undocumentable cause, factor, injury, illness or condition.'" 42 U.S.C. § 300aa-13(a)(2); *see also Doe/11 v. Sec'y of Health & Human Servs.*, 83 Fed. Cl. 157 (2008) (holding that an idiopathic diagnosis cannot be a "factor unrelated," as it is idiopathic).

As the foregoing confirms, multiple factors played into petitioner's development of an atypical GBS. Respondent failed to satisfy his burden that the URI three to four weeks prior to the influenza vaccine was the sole substantial factor in causing petitioner's GBS.

IV. Conclusion

Petitioner has put forth preponderant evidence that the influenza vaccine that he received on October 25, 2011 contributed to his development of an atypical Guillain-Barré Syndrome, and has therefore demonstrated entitlement to compensation. This case shall proceed to the damages phase.

IT IS SO ORDERED.

s/ Mindy Michaels Roth
Mindy Michaels Roth
Special Master